Casper Division
Production, U.S. & Canada

Marathon Oil Company

P.O. Box 2659
Casper, Wyoming 82602
Telephone 307/~~235-2511~~ 577-1555

Nebraska
14N 52W Sect 27
14 N 52W Sect 21

September 29, 1982

U.S.G.S. Core Library
Box 25046
Mail Stop 975
Denver Federal Center
Denver, Colorado 80225

ATTN: Mr. Bill Linenberger

Dear Bill:

Here are the duplicate thin sections from the two Diamond Shamrock cores which we sampled last November. Also enclosed is a set of photographs of the samples.

Sorry it has taken so long to get these samples to you.

Sincerely,

David M. Quattlebaum

David Quattlebaum
Geologist

DQ/ks

Enclosures

TABLE 2

Rock-Eval Pyrolysis Data from Paleozoic Samples in Nebraska

EPR No.	Depth (ft)	TOC	S1 mg/gm	S2 mg/gm	S3 mg/gm	HI	OI	T-Max
Southland #1 Cranmore C141								
77423A	5754	.03	0.02	0.47	0.91	1566	3033	-
B	5769	.03	0.02	0.37	1.10	1233	3666	-
Southland Royalty #1 Withers C142								
77424A	4848	10.83	5.04	77.69	2.35	717	21	422
B	4893	0.04	0.03	0.10	0.62	250	1550	-
C	4921.8	0.01	0.01	0.18	0.47	1880	4700	-
D	4963	0.09	0.02	1.14	0.38	1266	422	-
Diamond Shamrock #34-21 Christenson B582								
77425A	7077	0.04	0.03	0.51	0.22	1275	550	-
B	7102	0.01	0.02	0.14	0.54	1400	5400	-
Diamond Shamrock #1 Deaver B581								
77426A	7100	0.10	0.03	1.27	0.25	1270	250	-
Southland Royalty #1 Jensen C144								
77420A	5151.5	0.03	0.02	0.37	0.36	1233	1200	-
B	5172.5	0.09	0.0	1.19	0.34	1322	377	-
Southland Royalty #1 Rush Creek C143								
77421A	5043.5	0.01	0.02	0.20	0.61	2000	6100	-
B	5066.0	0.02	0.02	0.27	0.58	1350	2900	-
C	5077	0.03	0.04	0.34	0.65	1133	2166	-
D	5088	0.06	0.04	0.80	0.35	1333	583	-
American Petrofina #1 Toof C139								
77422A	5980.5	0.06	0.03	0.76	0.65	1266	1083	-
B	6002.5	0.03	0.02	0.36	1.04	1200	3466	-
C	6013.5	0.06	0.0	0.81	0.32	1350	533	-

B582

SUMMARY

Wells:

1. Diamond Shamrock Deaver Fee #12-27, Sec. 27, T.14N., R.52W., Cheyenne County, Nebraska.

2. Diamond Shamrock #1 D. Christensen Fee, Sec. 21, T.14N., R.52W., Cheyenne County, Nebraska. C582

Formation:

All samples were taken from the Upper Pennsylvanian Virgil Section, as reported by John Jenkins, Southland Royalty.

Average Lithologies:

1. Calcareous, anhydritic dolomite.
2. Anhydritic, algal limestones and dolomites.
3. Dolomitic, fossiliferous limestone.
4. Dolomitic, peloidal, algal limestone.
5. Calcareous, peloidal, algal dolomite.

Interpreted Environment of Deposition:

Two separate but contiguous depositional environments can be observed in both cores studied:

1. A supratidal, probably a highly evaporative or sabkha environment.
2. An intertidal to high intertidal environment.

Porosity Types (in order of decreasing abundance):

1. Intercrystalline: developed between individual dolomite, calcite, and anhydrite crystals.

2. Moldic and vuggy: developed mainly from the selective dissolution of fine, bioclastic material.

3. Interparticle: developed between individual detrital carbonate particles.

4. Intraparticle: Partial dissolution of unstable particles produces porosity within these particles.

5. Microporosity: those pores with aperture radii less than 0.5 microns.

6. Fracture: Microfractures are sparse, but were noted in some thin sections.

Porosity Controls:

1. Original sediment or particle size.

2. Recrystallization.

3. Dolomitization or partial dolomitization, increasing and/or decreasing porosity.

4. Amount of leaching of unstable carbonate particles, increasing porosity.

5. Amount of "secondary" calcite infilling, decreasing porosity.

6. Fracturing, increasing porosity and communication between zones.

The best reservoir rock was noted at 7107.1 feet in the Christensen Well, where many peloids have been leached out, creating abundant moldic porosity.

Diagenesis (for detailed discussion, see Diagenesis section in text):

All samples have undergone either supratidal, sabkha, or intertidal, shallow marine diagenesis.

RESULTS AND INTERPRETATIONS

Depositional Environment:

Two separate but continguous depositional environments can be observed in the two cores studied (see Figures 1 and 2).

1. A supratidal, probably a sabkha environment.
2. An intertidal to a high intertidal environment.

Supratidal rocks are characterized by calcareous, anhydritic dolomites and calcareous, anhydritic, algal dolomites and some limestones. Algae is of the laminated type, and is abundant in supratidal samples found in discrete zones. Also occurring in the supratidal zone is abundant micrite and no normal marine fossils.

Intertidal rocks are characterized by dolomitic, fossiliferous limestones, peloidal limestones, and peloidal, algal dolomites. Marine fossils are common in the intertidal rocks and include gastropods, echinoderms (echinoid spines), foraminifera, and ostracods. Many samples exhibit only scattered bioclasts and an abundance of broken shells. Lesser amounts of dolomite are observed in the intertidal samples than in the supratidal samples.

Both environments are considered typical of the low-lying Pennsylvanian carbonate shelf facies typical in the mid-continent (Wilson, 1975). The supratidal environment is thought to have undergone periodic exposure, and includes the formation of a typical Pennsylvanian paleosol named the "Red Shale Marker." The intertidal environment is interpreted to be of a normal marine facies. Deposition occurred mostly at or above wave base, with some minor deposition possibly occurring below wave base. Some intertidal samples (7107.1 in the Christensen) suggest that micrite periodically was winnowed out of this environment.

Overall, it appears that the Deaver Well contains more supratidal carbonate deposits than the Christensen Well, indicating a more basinward setting for the Christensen Well. It is interpreted that the more basinward setting for the Christensen Well has developed a better reservoir facies. The leaching of normal marine fossils and peloids, abundant in the intertidal areas, has developed better porosity than in the supratidal-dominated environment (Deaver Well). Supratidal diagenesis has obliterated much primary porosity in the supratidal zones. The majority of the porosity in the supratidal zones has been plugged by abundant micrite and anhydrite emplacement.

DIAGENESIS

Somewhat different diagenetic events have taken place with respect to the two adjacent environments of formation. In the supratidal environment samples, it is difficult to time later diagenetic events due to the disruptive nature of early diagenesis.

Some intertidal storm or lag sediments exhibit a supratidal diagenetic overprint, especially in the upper portions of both cores (see sequence below). This is interpreted to be related to an eustatic drop in sea level prior to intense marine cementation in the high intertidal zone. Due to the very flat expanse of the high shelf area, only a minor fluctuation in sea level may have initiated supratidal diagenesis in intertidal areas. For these samples (7071.4 and 7078.0 in the Deaver Well and 7059.0 in the Christensen Well), the supratidal diagenetic sequence will better explain observed features.

Supratidal Diagenesis:

The following sequence is inferred by petrographic observations for supratidal sediments in both cored intervals.

1. Deposition of calcareous mud, bioclastic particles, and peloids (minor pellets?).

2. Penecontemporaneous with Step 1 and prior to any lithification, many bioclasts and almost all peloids were micritized, probably by the action of algae and bacteria.

3. Partial leaching of carbonate mud (some may be dolomite), forming poorly developed vugs.

4. Formation of finely crystalline anhydrite; some carbonate particles may have been replaced by anhydrite.

5. Interpreted dolomitization of the majority of micrite and selective dolomitization of many fine carbonate particles (except at 7103.0 feet in the Deaver Well and 7096.6 feet in the Christensen Well).

6. Partial burial; anhydrite remobilization into vugs and those bioclastic chambers not completely filled with internal sediment (micrite). This secondary anhydrite is coarsely bladed, crystalline, and often poikilotopic infillings.

7. Deep burial, stylolitization; formation of secondary calcite spar (often poikilotopic) in open vugs. Possible further anhydrite remobilization.

8. Minor formation of secondary, large dolomite rhombohedrons, probably at the expense of secondary calcite spar.

9. Fracturing(?).

10. Emplacement of hydrocarbons, halting diagenesis.

Diagenesis - Intertidal:

The following sequence is inferred by petrographic observations for the majority of intertidal sediments in both cored intervals:

1. Deposition of carbonate mud and bioclastic particles, minor peloids, and minor clastic silts and clays (only observed at 7119.2 feet in the Deaver Well). Micrite may have been partially winnowed out in portions of this environment (e.g., 7107.1 feet in the Christensen Well).

2. Marine cementation in matrix (micrite)-poor samples. Radial-fibrous calcite cement is interpreted as being the most abundant.

3. Dissolution of unstable carbonate particles, forming moldic and vuggy porosities. May be ooids or peloids (see thin section photo 7107.1, Christensen Well).

4. Partial dolomitization; both a phreatic marine mixing model and an evaporative pumping model may be the dolomitizing mechanisms (Bathurst, 1976). It is interpreted that an evaporative pumping model would seem more reasonable in the Deaver Well due to its location with respect to the Christensen Well (see Environmental Interpretations).

4.-6. Neomorphism of some micrite to sparry and microspar calcite, in dolomite-poor samples.

5. Burial, stylolitization, and precipitation of minor calcite spar.

6. Formation of minor, large, secondary dolomite rhombohedrons at the expense of calcite spar.

7. Minor fracturing(?).

8. Hydrocarbon migration and emplacement, halting diagenesis.